Third United Nations International Conference on the Peaceful Uses of Atomic Energy

A/CONF.28/A/416
SWEDEN
February 1964
Original: ENGLISH

Confidential until official release during Conference

Abstract

A Crystal Diffraction Spectrometer for Non-destructive Burn-up Analysis

J. Rohlin [1], S. Nilsson [1], B. Lundqvist [1], R. Hardell [1]

A bent-crystal gamma-ray spectrometer has been built for burn-up measurements on reactor fuel elements. It will mainly be used adjusted to the Du Mond geometry. According to focusing properties a line-shaped source must then be used and consequently a very narrow part of the fuel element will be analyzed. The extension of the source is defined by slits in the radiation shield in front of the fuel element. The combined effect of slit geometry and gamma-ray self-absorption in the fuel element results in a suitable approximated line source.

The spectrometer can easily be changed for use also in the reversed (Cauchois-) geometry. In this case a larger part of the fuel element is studied, the size of which being mainly determined by the effective area of the diffraction crystal. In both cases a NaI-crystal is used as detector.

The bending radius of the diffraction crystal is four meters. Diffraction takes place against the (310)-planes in a 80 x 80 x 3 mm quartz crystal. The fuel element is placed in a radiation shield consisting of a transportable gas-sealed container, where it can be rotated and elevated in front of the source-defining slits. Consequently, a detailed analysis over the whole element surface is possible.

Determination of the burn-up is based on intensity measurements of diffraction peaks from fission product gamma lines. From measurements performed at our one-meter bent-crystal spectrometer the required gamma intensities of some selected fission products have been estimated. Calculations show that the intensities from the chosen gamma lines will be sufficient for obtaining diffraction peaks of reasonable statistics.

Work is going on aiming at the use of bent germanium crystals. This would increase the efficiency of the spectrometer by about one order of magnitude.

This work is performed under contract nr 163/RB with the International Atomic Energy Agency, Vienna.

1) Chalmers University of Technology, Göteborg